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WESTERN REGIONAL SPRING BARLEY NURSERY - 2004 Crop
Preliminary Quality Report

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Detailed Data:

Aberdeen, ID
Fairfield, ID
Idaho Falls, ID
Twin Falls, ID

Appendix:

Methods
Criteria for Quality Score

This is a joint progress report of cooperative investigations being conducted in the Agricultural Research Service of the U.S. Department of Agriculture and State Agricultural Experiment Stations. It contains preliminary data that have not been sufficiently confirmed to justify general release; interpretations may be modified with additional experimentation. Confirmed results will be published through established channels. The report is primarily a tool available to cooperators and their official staffs and for those persons who have a direct and special interest in the development of improved barleys.

This report includes data furnished by the Agricultural Research Service as well as by the State Agricultural Experiment Stations. The report is not intended for publication and should not be referred to in literature citations nor quoted in publicity or advertising. Use of the data may be granted for certain purposes upon written request to the agency or agencies involved.

Samples malted and analyzed by the Cereal Crops Research Unit, Madison, WI

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Western Regional Spring Barley Nursery – 2004 Crop

Nursery samples were received for malting quality evaluation from four experimental stations located in Idaho. The parentages of the nursery entries are listed in Table 1. Twenty of the 36 entries were new in this year's nursery.

These samples were germinated for 5 days and rotated for 3 minutes every half hour, which should yield malts having modification levels similar to those produced by industry. The malting conditions and analytical methods employed are listed in Appendix A. The criteria and value assignments used to calculate quality scores are listed in Appendix B.

The mean values for 16 quality factors are listed over the four stations located in the Western Region (Table 2) and over all varieties (Table 3). Individual station data are reported in Tables 4 through 7. Evaluations of data from individual locations and overall performance evaluations, derived primarily from Tables 2 and 3, are presented below.

Most of the plump barleys from Aberdeen (Table 4) had good protein contents. A quarter of the extract values fell below desired limits, however several were over 81%. Two thirds of the wort protein levels were unacceptably low and those low soluble protein values contributed to the generally low S/T ratios. Half of the diastatic power values were below desired limits, while α -amylase levels were generally good. Over half of the β -glucan levels were too high, while a third of the free amino nitrogen levels were too low. Over two thirds of the viscosity and turbidity values exceeded desired limits. The best performers were 6B98-9022, 2B97-4004, 6B99-9170, ND16301 and Harrington. 6B98-9022 and 2B97-4004 scored very well achieving nearly ideal values for most of the quality parameters assessed. 6B99-9170 also performed well, but had a slightly elevated S/T ratio. ND16301 had the highest (still acceptable) diastatic power value of the malts derived from this location. Note it's slightly elevated viscosity. The Harrington experimental check performed quite well, but had slightly elevated β -glucan and turbidity values.

Most of the submissions from Fairfield (Table 5) were plump, with good protein contents. However, a third of the extract values were unacceptably low, while over half of the F-C differences were too high, suggesting poor carbohydrate modification. Two thirds of the

soluble protein and S/T values were unacceptably low and half of the free amino nitrogen values were below desired levels, indicating poor protein modification. Three quarters of the β -glucan and turbidity levels were too high, and most of the viscosities exceeded desired values. The best performers were Stander, 6B99-9170 and 98Ab12905. Stander had slightly elevated viscosity and turbidity values. 6B99-9170 and 98Ab12905 had high viscosity and β -glucan values, indicative of poor carbohydrate modification, however these lines were similar to the Morex experimental control. 98Ab12905 had an elevated S/T ratio and also generated the highest free amino nitrogen levels from this location indicating the potential for rapid protein modification.

Half of the protein contents of the plump submissions from Idaho Falls (Table 6) were too low. The extract values were very good, with the exception of the malts from 'feed' type barleys, and most F-C differences were good. Half of the wort protein, S/T and diastatic power values were too low, while over half of the β -glucan, viscosity and turbidity values were too high. The best performers were Stander, Morex, 6B98-9022, ND16301 and MT981238. Stander had very good malt quality values, except for elevated S/T and β -glucan values. 6B98-9022 had excellent malt quality, except for an elevated S/T ratio due in part to the somewhat low barley protein contents. The Morex experimental control had elevated β -glucan and viscosity values. ND16301 had low total protein content and this contributed to an unacceptably high S/T ratio. Note that ND16301 had an elevated turbidity and a viscosity that slightly exceeded the desired limit. MT981238 performed well, except for unacceptably high β -glucan content and a viscosity that exceeded the desired limit.

The barleys from Twin Falls (Table 7) were generally plump, but two thirds of the protein contents were lower than the desired limits. Extract values were generally good, except for the 'feed' type malts. Around half of the soluble protein, S/T, diastatic power and free amino nitrogen values were below desired limits. Over two thirds of the β -glucan and turbidity values were too high and all viscosities exceeded the desired limit. The best performers were 2B99-2316, MT981238, 6B98-9022 and 2B97-4004. 2B99-2316 and 2B97-4004 had elevated S/T ratios. MT981238 and 6B98-9022 had unacceptably high β -glucan levels. Note that the viscosity of 6B98-9022 was very high.

The barleys in this year's nursery generally performed best when grown at Aberdeen (Table 2). These barleys were plump and had good protein contents. Mean extract values were

good and the averaged β -glucan, free amino nitrogen and viscosity values were nearest the desired range. Idaho Falls and Twin Falls yielded very similar averaged results. The barleys were fairly plump, but protein contents were generally a bit too low. The averaged malt extract values for these two locations were very good and would have been even higher if the feed type barleys had been removed from the statistical analysis. Beta-glucan levels and viscosities were elevated beyond the desired limits. The submissions from Fairfield were least plump, but generally had good protein contents. Wort protein levels were low, while β -glucan levels were extremely high. The averaged wort viscosities were unacceptably high at this location and substantially higher than those from the other locations.

The best performers in the WRSBN were 6B98-9022, Stander, 6B99-9170, ND16301, 2B97-4004, MT98-1238, 2B99-2316, Morex, WA1701-99, Harrington and 2B99-2657. The 6B98-9022 from three of four locations performed very well. This line was plump, had great extract values and balanced modification, except for the malt derived from the Fairfield grown barley, where protein modification was poor. Note that elevated viscosities (in two of four locations) might be of concern. Stander performed well at Fairfield and Idaho Falls, where it ranked first for quality score. Stander did not have balanced modification, with protein modification progressing faster than carbohydrate modification. 6B99-9170 performed well at three of four locations. Modification was fairly well balanced. This line had very good extract values averaging over one per cent higher than the Morex experimental check. ND16301 generally had balanced modification. Possible issues for this line include elevated viscosity and turbidity. 2B97-4004 generated exceptional extract values, averaging 82.7%. This line tended to modify quickly with our standard malting protocol, resulting in the lowest average β -glucan levels in the nursery, but also unacceptably high S/T ratios in three of four locations. MT98-1238 had good protein modification, however the carbohydrate modification was poor, resulting in unacceptably high F-C and β -glucan values. 2B99-2316 had excellent extract values, averaging 82.4%; most other parameters were good. Note that the average α -amylase value was very high at 83.1 DU and that the S/T ratios were unacceptably high in three of four locations. The Morex experimental check was a bit thinner than most submissions, as is normally the case. Our standardized malting protocol yielded a slightly under-modified malt. WA1701-99 was a bit thin, but had good extract values. Protein modification appeared to have progressed more quickly than

the carbohydrate modification. As a result, S/T ratios and β -glucan contents were high. The Harrington experimental check performed well in three of four locations. 2B99-2657 had an exceptional averaged extract of 82.7%. This line yielded good soluble protein and diastatic power values even with low total protein content. Note that 2B99-2657 had the highest average α -amylase values in this nursery.

Table 1 - 2004 Western Regional Spring Barley Nursery Entries and Parentage

Seed Source	Entry No.	Entry	Parentage	Row Type	Grade	Years Tested	Cooperator
WSU	1	Steptoe	CI 15229	6	feed	Check	Ullrich, Vjtkov
WPB	2	Baronesse	PI 568246	2	feed	Check	Clark, Cook
USDA-ARS	3	Morex	CI 15773	6	malting	Check	Erickson
USDA-ARS	4	Stander	PI 564743	6	malting	Check	Erickson
USDA-ARS	5	Harrington	Klages/3/Gazelle/Betzes//Centenial	2	malting	Check	Erickson
BARI	6	2B97-4004	2B91-4947/TR129	2	malting	2	Cooper, Selmer
BARI	7 *	2B99-2316	2B91-4947//2B91-4947/2B95-8129	2	malting	0	Cooper, Selmer
BARI	8 *	2B99-2657	2B91-4947//2B91-4947/2B94-5744	2	malting	0	Cooper, Selmer
BARI	9 *	6B98-9022	6B92-7098/6B92-7166	6	malting	0	Cooper, Selmer
BARI	10 *	6B98-9170	6B92-7098//6B92-7098/M75	6	malting	0	Cooper, Selmer
USDA-ARS	11	94Ab13449	Russell/M64	6	malting	2	Obert
USDA-ARS	12 *	98Ab11993	90Ab241/Baronesse	2	malting	0	Obert
USDA-ARS	13	98Ab12905	88Y315/82Ab519//M64	6	malting	2	Obert
USDA-ARS	14 *	98ID251	Baronesse/3/Crystal//Klages*3/PI 366450	2	feed, RWA res.	0	Bregitzer
WPB	15 *	BZ 598-036	Baronesse/Gus	2	feed	0	Clark, Cook
WPB	16 *	YU 597-432	Baronesse/Orca	2	feed	0	Clark, Cook
WPB	17	YU598-043	Baronesse/Gus	2	feed,semi-dwarf	1	Clark, Cook
MSU	18	MT970229	MT890021/Stark	2	feed/malting	1	Blake/Hensleigh
MSU	19 *	MT981091	MT851195/MT140523	2	feed/malting	0	Blake/Hensleigh
MSU	20 *	MT981238	ND112311/Lewis	2	feed/malting	0	Blake/Hensleigh
NDSU	21 *	ND16301	Foster//ND12200(Bumper/Hazen//Azure)/6B88-3213	6	malting	0	Horsley
NDSU	22 *	ND19854	ND15403/ND16462	2	feed	0	Franckowiak
PB1	23	PB1-95-2R-522	PB1-88-2R-801/VD403582	2	feed	2	McProud
PB1	24 *	PB1-97-2R-7010	PB1-88-2R-801/ND 9147	2	feed/malting	0	McProud
Lewis	25	Samish 23	85Ab2323/Acclaim	2	feed/malting	1	Lewis
USU	26	UT97B1480-1534	UT89B747-1263/UT90B774-2467	6	feed	1	Roche
USU	27 *	UT00B1712-627		6	feed	0	Roche
USU	28 *	UT00B1718-773		6	feed	0	Roche
WSU	29 *	WA 8569-99	7190-86/Baronesse(WA 7642-92)//C2-91-45-16-3	2	feed/malting	0	Ullrich, Vjtkov
WSU	30	WA 8601-97	WA7758-89/Baronesse	2	feed/malting	1	Ullrich, Vjtkov
WSU	31 *	WA 9701-99	9029-84/EBC-187(WA 7114-93)//Baronesse	2	feed/malting	0	Ullrich, Vjtkov
WSU	32	WA 10497-97	WA9035-84/Baronesse	2	feed/malting	1	Ullrich, Vjtkov
WSU	33 *	WA 10701-99	Clivia/9448-83(WA 7758-89)//Logan	2	feed/malting	0	Ullrich, Vjtkov
USDA-ARS	34	Radiant (98-NZ 223)	ant 29-667 [Harrington]/Baronesse	2	feed/malting	2	Wettstein
WSU	35 *	00NZ772	Ca803208/3/DB121//ant 499(Apex)/Bancroft	2	feed/malting	0	Wettstein
WSU	36 *	99NZ102	12697-94[ant 643]/939331-91	6	feed/malting	0	Wettstein

* new entries

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Table 2 - Station Means* of Barley and Malt Quality Factors for 36 Varieties or Selections**

Location	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	F-C	Wort Color	Wort Clarity	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha- amylase (20°DU)	Beta- glucan (ppm)	FAN (ppm)	Viscosity (Relative)	Turbidity (Hach)	Quality Score															
Aberdeen	41.5	A	92.3	AB	55	D	79.1	C	1.1	B	2.4	A	1.6	B	11.9	A	4.52	A	40.0	B	110	58.8	AB	219	C	186	A	1.52	C	23.7	B	38
Fairfield	40.3	B	85.8	C	77	A	78.4	D	1.7	A	2.2	B	1.9	A	12.0	A	4.29	B	37.9	C	114	53.6	C	419	A	158	C	1.66	A	27.4	AB	32
Idaho Falls	41.8	A	93.4	A	75	B	80.1	A	0.9	B	2.1	B	1.8	AB	10.9	B	4.56	A	44.1	A	111	60.0	A	293	B	176	AB	1.54	C	28.9	A	35
Twin Falls	39.4	C	90.1	B	66	C	79.6	B	1.0	B	2.0	B	1.8	AB	11.0	B	4.56	A	44.2	A	111	55.7	BC	307	B	168	BC	1.58	B	22.6	B	34

* Within each column, means followed by the same letter are not significantly different (alpha=0.05), according to Duncan's Multiple Range Test

** Steptoe, Baronesse, Morex, Stander, Harrington, 2B97-4004, 2B99-2316, 2B99-2657, 6B98-9022, 6B99-9170, 94Ab13449, 98Ab11993, 98Ab12905, 98ID251, BZ 598-036, YU 597-432, YU598-043, MT970229, MT981091, MT981238, ND16301, ND19854, PB1-95-2R-522, PB1-97-2R-7010, Samish 23, UT97B1480-1534, UT00B1712-627, UT00B1718-773, WA 8569-99, WA 8601-97, WA 9701-99, WA 10497-97, WA 10701-99, Radiant (98-NZ 223), 00NZ772, 99NZ102

Table 3 - WESTERN REGIONAL SPRING BARLEY NURSERY - 2004 Crop

Varietal Means* of Barley and Malt Quality Factors for all Stations**

Variety or Selection	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	F-C (%)	Wort Color	Wort Clarity	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (*ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	FAN (ppm)	Visc. (Rel.)	Turb. (Hach)	Quality Score																
Steptoe	42.1	DEFGHI	94.5	AB	69	BCDEFG	75.8	R	2.0	BC	3.14	A	3.0	A	9.9	E	3.25	Q	34.3	JK	76	KL	42.6	IJ	769	A	115	M	1.76	B	59.0	AB	18
Baronesse	42.0	DEFGHI	92.0	ABCDEF	69	BCDEFGH	77.2	OPQ	1.4	BCDEFGHI	2.34	CDEFGH	2.8	AB	11.8	ABC	3.86	OP	34.1	K	108	EFGHIJ	48.6	HIJ	336	EFGHI	125	JKLM	1.59	CD	35.8	DEFG	24
Morex	34.8	S	82.3	HI	71	ABCDEF	79.2	GHIJKL	0.9	EFGHI	1.64	GH	1.0	E	12.4	AB	4.84	CDEF	40.5	FG	152	ABC	55.0	GHI	262	FGHIJKL	182	EFGH	1.55	CD	9.4	K	46
Stander	36.1	RS	89.1	ABCDEFGHI	75	ABC	80.1	EFGHI	0.8	EFGHI	1.95	EFGH	1.3	E	11.7	ABCD	5.09	ABC	46.9	CD	148	ABC	67.4	DEF	233	GHIJKLM	221	ABCD	1.54	CD	13.3	IJK	51
Harrington	40.8	GHIJKL	88.8	ABCDEFGHI	71	ABCDEF	80.9	CDEF	0.8	EFGHI	1.89	FGH	1.0	E	11.8	ABCD	5.22	ABC	47.1	CD	132	BCDE	76.4	BCD	227	GHIJKLM	225	ABC	1.53	CD	9.7	JK	43
2B97-4004	39.1	KL MNOP	89.0	ABCDEFGHI	70	BCDEF	82.7	A	0.6	HI	2.01	EFGH	1.0	E	11.3	ABCDE	5.39	A	50.6	ABC	130	CDEF	79.8	ABC	65	N	229	ABC	1.50	D	10.0	JK	48
2B99-2316	40.1	IJKLMN	91.5	ABCDEFG	69	CDEFGH	82.4	AB	0.6	GHI	1.80	FGH	1.0	E	10.8	CDE	4.98	BCDE	49.4	BC	137	BCD	83.1	AB	112	LMN	216	ABCDE	1.49	D	6.6	K	46
2B99-2657	38.7	LMNOPQ	90.5	ABCDEFGH	75	ABC	82.7	A	0.6	I	1.80	FGH	1.0	E	10.3	DE	4.98	BCDE	51.2	AB	133	BCDE	90.3	A	81	MN	189	DEFG	1.50	D	8.8	K	41
6B98-9022	36.9	PQRS	94.9	AB	73	ABCD	79.9	FGHJ	0.8	EFGHI	1.78	FGH	1.3	E	11.5	ABCD	4.89	CDE	44.7	DE	158	AB	64.6	DEFG	155	KL MN	189	DEFG	1.55	CD	15.7	HIJK	53
6B99-9170	37.4	OPQR	89.6	ABCDEFGHI	76	A	80.5	DEFG	0.6	HI	1.80	FGH	1.0	E	11.7	ABCD	5.36	A	48.7	BCD	147	ABC	69.1	CDE	216	HIJKLMN	226	ABC	1.53	CD	8.1	K	50
94Ab13449	36.2	RS	85.5	CDEFGHI	65	FGHIJ	80.5	DEFG	1.2	CDEFGHI	3.05	ABC	2.8	AB	10.8	CDE	4.71	DEFG	47.2	BCD	127	CDEFG	56.1	FGH	177	JKLMN	199	CDEF	1.56	CD	60.3	A	41
98Ab11993	41.5	EF GHIJ	95.4	AB	65	FGHIJ	81.2	BCDE	0.6	HI	1.57	GH	1.0	E	11.0	BCDE	4.66	EFGH	44.7	DE	94	HIJK	71.5	BCDE	143	KL MN	188	DEFG	1.55	CD	7.6	K	39
98Ab12905	36.4	QRS	90.6	ABCDEFGH	66	EF GHI	81.8	ABC	0.9	EF GHI	2.36	CDEFGH	1.0	E	10.3	DE	5.06	ABCD	53.5	A	103	F GHIJK	74.8	BCDE	297	F GHIJK	237	AB	1.60	CD	18.0	HIJK	40
98ID251	44.9	ABC	92.9	ABCDEF	75	ABC	78.4	KL MN O	0.9	EF GHI	1.71	FGH	1.0	E	12.3	AB	4.51	F GHI	38.2	GHIJK	102	GHIJK	56.7	FGH	238	GHIJKLM	158	GHIJK	1.56	CD	11.3	JK	33
BZ 598-036	44.5	ABC	95.0	AB	63	HIJK	78.1	LMNO	1.2	CDEFGHI	2.96	ABC	2.8	AB	11.7	ABCD	3.95	MNO	37.3	GHIJK	90	IJK	49.0	HIJ	267	F GHIJKL	136	IJKLM	1.56	CD	43.5	BCDEF	48
YU 597-432	43.1	CDEFG	92.0	ABCDEF	60	JK	79.5	GHIJK	1.0	DEFGHI	1.62	GH	1.3	E	12.1	ABC	4.41	GHIJKL	38.1	GHIJK	131	BCDE	63.7	EFG	213	HIJKLMN	154	GHIJKL	1.56	CD	10.8	JK	40
YU598-043	45.8	AB	94.5	AB	62	IJK	76.7	PQR	1.5	BCDEF	2.80	ABCD	2.5	ABC	12.0	ABC	4.05	KL MN O	35.5	IJK	85	IJKL	46.0	HIJ	458	BCDE	126		1.64	C	43.0	CDEFG	23
MT970229	46.0	A	96.5	A	71	ABCDEF	78.9	JKLMN	0.9	EF GHI	3.13	AB	2.8	AB	11.6	ABCD	4.21	IJKLMNO	38.1	GHIJK	92	HIJK	45.5	HIJ	407	BCDEF	145	IJKLM	1.58	CD	53.3	ABC	26
MT981091	43.7	BCDE	91.7	ABCDEFG	63	GHIJK	79.8	F GHIJ	1.5	BCDEFGH	1.56	H	1.5	DE	11.0	BCDE	3.97	MNO	38.6	GHIJ	101	GHIJK	41.8	J	400	BCDEF	139	IJKLM	1.55	CD	12.0	JK	32
MT981238	45.1	ABC	92.1	ABCDEF	70	BCDEF	79.8	F GHIJ	1.2	CDEFGHI	1.65	GH	1.0	E	12.6	A	5.18	ABC	42.8	EF	119	DEFGH	72.1	BCDE	455	BCDE	205	BCDE	1.56	CD	7.2	K	47
ND16301	37.3	OPQR	92.2	ABCDEF	75	AB	80.2	EFGHI	0.7	F GHI	2.18	DEFGH	1.5	DE	11.2	ABCDE	4.86	CDEF	45.1	DE	163	A	64.2	DEFG	149	KL MN	199	CDEF	1.57	CD	29.0	F GHI	49
ND19854	42.8	CDEFGH	94.0	ABC	68	CDEFGH	80.4	DEFGH	0.9	EF GHI	2.72	ABCDE	2.5	ABC	11.3	ABCDE	4.44	GHIJ	40.2	FGH	132	BCDE	54.8	GHI	366	DEFGH	160	GHIJ	1.59	CD	60.3	A	38
PB1-95-2R-522	44.1	ABCD	84.6		70	ABCDEF	77.7	NOP	1.7	BCDE	1.74	FGH	1.5	DE	11.5	ABCD	3.97	MNO	36.7	GHIJK	63	L	41.2	J	527	BC	141	IJKLM	1.63	C	18.1	HIJK	21
PB1-97-2R-7010	45.6	AB	93.2	ABCDE	68	CDEFGH	78.9	IJKLMN	1.3	BCDEFGHI	2.29	CDEFGH	2.0	CD	11.2	ABCDE	4.07	JKLMNO	38.6	GHI	100	GHIJK	39.7	JK	392	BCDEF	136	IJKLM	1.59	CD	30.9	EF GH	28
Samish 23	40.4	HIJKLM	91.1	ABCDEFG	69	CDEFGH	78.8	JKLMN	2.2	B	1.88	FGH	2.0	CD	12.0	ABC	4.23	IJKLMNO	37.6	GHIJK	94	HIJK	37.6	JK	534	B	150	HIJKLM	1.62	C	29.5	F GHI	25
UT97B1480-1534	36.3	RS	83.3	GHI	61	IJK	74.4	S	3.4	A	1.87	FGH	2.3	BC	12.3	ABC	3.55	PQ	30.1	L	87	IJKL	29.4	K	794	A	119	LM	1.88	A	26.5	GHIJ	15
UT00B1712-627	40.5	HIJKLM	94.0	ABC	60	JK	76.3	QR	1.3	BCDEFGHI	2.83	ABCD	2.5	ABC	11.7	ABCD	4.43	GHIJK	39.5	F GHI	130	CDEF	41.3	J	510	BCD	164	GHI	1.60	CD	42.0	CDEFG	28
UT00B1718-773	38.0	NOPQR	92.9	ABCDEF	59	K	76.1	QR	1.5	BCDEFG	3.00	ABC	2.5	ABC	11.2	ABCDE	3.89	NOP	36.2	HIJK	95	HIJK	43.1	IJ	508	BCD	141	IJKLM	1.62	C	47.8	ABCD	20
WA 8569-99	41.3	F GHIJK	87.1	BCDEFGHI	70	ABCDEF	77.9	MNOP	1.8	BCD	2.29	CDEFGH	2.5	ABC	11.5	ABCD	3.89	NOP	35.8	IJK	90	IJK	42.4	IJ	378	CDEFG	168	F GHI	1.62	C	36.3	DEFG	22
WA 8601-97	43.3	CDEF	89.4	ABCDEFGHI	68	CDEFGH	78.3	KL MN O	1.3	BCDEFGHI	2.48	ABCDEF	2.8	AB	11.8	ABCD	4.05	LMNO	35.7	IJK	82	JKL	46.1	HIJ	232	GHIJKLM	127	JKLM	1.54	CD	46.3	ABCDE	28
WA 9701-99	39.5	JKLMNO	90.7	ABCDEFG	69	BCDEFG	79.1	IJKLM	1.0	DEFGHI	2.37	BCDEFG	2.8	AB	11.2	ABCDE	3.97	MNO	38.5	GHIJ	100	GHIJK	47.4	HIJ	116	LMN	123	KLM	1.54	CD	35.0	DEFG	30
WA 10497-97	40.8	GHIJKL	93.8	ABCD	73	ABCD	79.1	HIJKLM	1.1	DEFGHI	1.61	GH	1.0	E	11.4	ABCD	4.31	HIJKLM	40.3	FGH	102	GHIJK	49.7	HIJ	324	EF GHIJ	161	GHIJ	1.55	CD	12.4	JK	33
WA 10701-99	41.8	DEFGHIJ	85.3	DEFGHI	72	ABCDE	81.5	BCD	0.7	F GHI	1.62	GH	1.0	E	11.7	ABCD	5.39	A	49.6	ABC	107	EF GHIJ	72.3	BCDE	212	HIJKLMN	232	ABC	1.50	D	8.0	K	43
Radiant (98-NZ 223)	40.8	GHIJKL	85.1	EF GHI	68	CDEFGH	80.3	DEFGH	1.2	CDEFGHI	2.11	DEFGH	1.0	E	11.1	ABCDE	4.26	IJKLMN	40.5	FG	94	HIJK	66.4	DEFG	186	IJKLMN	158	GHIJK	1.53	CD	11.9	JK	35
00NZ772	40.2	IJKLMN	87.4	BCDEFGHI	68	DEFGH	80.9		1.1	DEFGHI	2.18	DEFGH	1.3	E	11.3	ABCDE	4.25	IJKLMN	39.6	F GHI	90	IJK	47.8	HIJ	228	GHIJKLM	167	F GHI	1.53	CD	18.2	HIJK	34
99NZ102	38.3	MNOPQR	82.2	I	66	EF GHI	78.9	IJKLMN	0.9	EF GHI	2.48	ABCDEF	2.0	CD	10.8	CDE	5.29	AB	50.2	ABC	112	DEFGHI	75.3	BCDE	173	JKLMN	242	A	1.54	CD	28.8	F GHI	39

* Within each column, means followed by the same letter are not significantly different (alpha=0.05), according to Duncan's Multiple Range Test

** Aberdeen, ID, Idaho Falls, ID, Fairfield, ID, and Twin Falls, ID

2004 WESTERN REGIONAL SPRING BARLEY NURSERY and ADDITIONS - ABERDEEN, ID

Table 4

Lab No.	Variety or Selection	Rowed	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	F-C (%)	Wort Color	Wort Clarity	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	FAN (ppm)	Visc. (Rel.)	Turb. (Hach)	Quality Score	Overall Rank
5108	Steptoe	6	40.9	93.4	52	75.9	*2.4	n.d.	3	10.6	3.28	33.5	61	34.9	*660	150	1.57	54.0	15	40
5109	Baronesse	2	41.7	91.1	57	76.9	1.6	n.d.	3	12.6	3.92	32.8	86	47.4	314	155	1.53	35.0	26	34
5110	Morex	6	35.1	87.6	57	79.9	0.8	1.7	1	11.7	4.40	38.7	138	58.9	182	155	1.49	9.6	46	9
5111	Stander	6	35.9	87.6	61	80.1	1.2	2.0	2	12.0	4.58	41.2	133	63.6	261	204	1.50	18.9	42	15
5112	Harrington	2	40.9	88.3	55	81.1	1.0	2.0	1	11.9	5.19	46.1	118	75.0	208	243	1.50	13.3	52	5
5113	2B97-4004	2	39.5	86.9	54	81.4	1.5	2.2	1	12.7	5.44	46.0	127	74.1	99	229	1.49	10.9	60	2
5114	2B99-2316	2	41.1	91.8	57	82.3	1.1	2.0	1	10.6	4.83	46.9	119	86.1	178	230	1.50	7.4	45	12
5115	2B99-2657	2	38.8	90.2	61	82.0	1.3	2.1	1	10.9	5.03	47.3	115	96.0	122	145	1.50	11.4	38	20
5116	6B98-9022	6	37.4	95.9	59	79.8	0.5	1.9	1	11.8	5.12	44.5	145	67.5	133	222	1.49	8.9	61	1
5117	6B99-9170	6	38.9	92.6	64	80.5	0.7	1.9	1	12.1	5.38	47.2	141	70.2	158	250	1.49	8.2	56	3
5118	94Ab13449	6	36.9	90.9	56	81.2	0.9	n.d.	3	10.6	4.59	45.8	108	57.3	127	211	1.53	42.0	44	14
5119	98Ab11993	2	43.5	97.5	50	81.0	1.0	1.6	1	11.8	4.54	39.8	95	69.1	153	193	1.52	5.7	42	15
5120	98Ab12905	6	37.1	90.8	54	82.3	0.2	2.7	1	10.3	5.08	54.1	95	73.2	221	268	1.55	19.0	37	21
5121	98ID251	2	45.9	95.5	63	79.0	0.2	2.0	1	11.9	4.61	40.7	99	59.7	116	181	1.56	12.7	39	18
5122	BZ 598-036	2	45.3	95.8	49	78.7	1.2	n.d.	3	11.5	4.04	38.5	88	55.2	103	160	1.51	51.0	33	30
5123	YU 597-432	2	44.0	93.0	49	79.0	0.5	1.9	1	12.8	4.82	38.0	140	71.9	147	195	1.56	11.0	46	9
5124	YU598-043	2	46.6	96.6	51	76.1	1.0	3.0	2	13.2	4.23	34.3	98	50.1	274	134	1.57	39.0	23	37
5126	MT970229	2	45.0	96.7	63	78.7	0.7	n.d.	3	12.2	4.31	37.4	102	53.4	224	168	1.52	63.0	35	26
5127	MT981091	2	43.7	92.2	50	79.1	1.4	1.7	1	11.8	4.04	37.2	103	45.0	261	150	1.50	9.2	34	27
5128	MT981238	2	46.9	93.4	61	79.5	1.1	1.8	1	13.2	5.25	40.6	134	75.2	287	225	1.52	6.1	45	12
5129	ND16301	6	38.2	94.1	60	79.9	0.2	1.8	1	12.3	5.11	43.0	*188	66.0	66	217	1.53	8.9	54	4
5130	ND19854	2	43.2	93.2	58	80.5	0.3	3.0	2	11.3	4.46	39.7	124	55.8	217	165	1.51	54.0	37	21
5131	PB1-95-2R-522	2	46.5	90.2	57	77.4	0.2	2.1	1	12.6	4.09	35.0	69	44.3	312	149	1.51	16.6	26	34
5132	PB1-97-2R-7010	2	47.0	97.6	54	78.7	1.2	2.2	1	12.0	4.31	36.8	109	44.9	209	161	1.51	20.0	34	27
5133	Samish 23	2	42.2	95.2	55	79.2	1.4	1.9	1	12.7	4.27	36.4	96	41.5	305	162	1.51	14.5	30	33
5134	UT97B1480-1534	6	37.0	90.2	48	74.6	*4.0	2.0	2	12.2	3.45	28.7	85	29.7	*580	115	*1.70	25.0	21	39
5135	UT00B1712-627	6	41.0	95.2	49	76.6	1.0	2.8	2	12.0	4.39	39.6	128	45.9	348	178	1.54	34.0	32	32
5136	UT00B1718-773	6	38.4	93.1	43	76.1	0.6	3.3	2	10.7	3.71	36.6	92	45.4	246	147	1.53	49.0	23	37
5137	WA 8569-99	2	42.1	91.9	56	77.7	1.5	2.8	2	12.1	3.91	33.0	86	44.3	255	140	1.55	36.0	25	36
5138	WA 8601-97	2	45.6	96.6	52	78.8	1.3	3.3	2	11.6	4.01	35.7	79	49.6	103	142	1.49	46.0	39	18

Table 4

Lab No.	Variety or Selection	Rowed	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	F-C (%)	Wort Color	Wort Clarity	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	FAN (ppm)	Visc. (Rel.)	Turb. (Hach)	Quality Score	Overall Rank
5139	WA 9701-99	2	41.2	93.1	50	77.5	1.4	2.4	2	13.3	4.16	33.2	117	50.7	93	146	1.50	31.0	33	30
5140	WA 10497-97	2	42.6	94.2	57	78.7	0.9	1.9	1	12.2	4.40	38.4	108	52.4	201	176	1.49	12.3	37	21
5141	WA 10701-99	2	42.0	87.9	57	80.8	1.1	1.7	1	12.7	5.35	45.4	120	70.6	176	265	1.49	6.2	52	5
5142	Radiant (98-NZ 223)	2	43.3	88.6	56	79.4	1.2	1.8	1	12.4	4.29	37.5	96	70.2	134	186	1.48	7.0	34	27
5143	00NZ772	2	42.2	94.6	54	80.6	0.9	2.3	1	12.0	4.62	39.8	86	49.9	179	194	1.52	23.0	42	15
5144	99NZ102	6	36.5	*77.5	54	77.9	0.7	3.0	2	11.8	5.61	50.6	117	72.8	227	267	1.56	33.0	37	21
5145	Colter	6	37.8	82.1	54	80.9	0.6	1.8	1	9.8	4.16	44.3	100	56.2	135	182	1.53	9.7	46	9
5146	Creel	6	38.6	*79.9	59	79.4	0.5	1.7	1	10.4	4.10	40.7	127	55.1	227	177	1.51	8.7	36	25
5147	Garnet	2	46.3	97.6	65	81.5	0.2	2.2	1	10.8	5.30	53.8	116	73.9	139	205	1.49	9.1	48	8
5148	Crystal	2	45.8	96.4	71	80.4	0.9	2.0	1	12.5	5.21	44.0	115	75.4	254	221	1.51	7.8	52	5
5125	HARRINGTON MALT CHECK	2	38.2	87.2	81	81.9	0.3	1.7	1	13.0	5.79	47.7	138	87.2	84	290	1.50	5.1	48	
5149	HARRINGTON MALT CHECK	2	39.4	86.8	79	81.9	0.8	1.6	1	13.1	5.80	46.3	133	85.6	146	270	1.50	4.3	44	
Minima			35.1	82.1	43	74.6	0.2	1.6		9.8	3.28	28.7	61	29.7	66	115	1.5	5.7	15	
Maxima			47.0	97.6	71	82.3	1.6	3.3		13.3	5.61	54.1	145	96.0	348	268	1.6	63.0	61	
Means			41.6	92.6	57	79.3	0.9	2.2		11.8	4.54	40.6	108	59.5	195	187	1.5	22.2	39	
Standard Deviations			3.5	3.6	5	1.9	0.4	0.5		0.9	0.57	5.8	20	14.4	72	40	0.0	16.6	11	
Coefficients of Variation			8.4	3.8	10	2.4	45.5	22.3		7.3	12.60	14.3	19	24.1	37	21	1.7	74.8	28	

Malt Check Data are Excluded from Rank Sorting and Statistics

Table Data Flagged by an Asterisk Exceed the Mean by +/- 3 Standard Deviations and are Excluded from Statistics

For Wort Clarity - 1 = clear, 2 = slightly hazy, 3 = hazy; Wort Colors were not determined (n.d.) on hazy samples

Samples Submitted by D. Obert, USDA/ARS - Aberdeen

2004 WESTERN REGIONAL SPRING BARLEY NURSERY - FAIRFIELD, ID

Table 5

Lab No.	Variety or Selection	Rowed	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	F-C (%)	Wort Color	Wort Clarity	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	FAN (ppm)	Visc. (Rel.)	Turb. (Hach)	Quality Score	Overall Rank
5291	Steptoe	6	42.5	93.1	80	75.2	1.6	n.d.	3	9.7	3.19	32.9	58	32.8	762	102	1.88	56.0	15	33
5292	Baronesse	2	40.8	85.5	77	75.9	1.8	2.1	2	13.1	3.67	29.9	92	40.8	462	109	1.70	34.0	17	32
5293	Morex	6	34.0	68.2	84	78.3	1.0	1.9	1	12.4	4.68	38.6	173	54.9	245	171	1.58	12.6	38	14
5294	Stander	6	34.7	80.5	84	79.4	0.6	2.4	1	12.0	4.93	43.2	146	65.9	190	209	1.55	15.6	57	1
5295	Harrington	2	40.7	92.6	80	81.2	0.4	2.5	1	10.9	4.74	46.7	112	72.3	199	191	1.55	6.6	48	5
5296	2B97-4004	2	38.8	89.0	81	83.3	0.4	1.9	1	10.7	5.07	51.1	119	78.1	60	220	1.50	7.3	43	7
5297	2B99-2316	2	40.7	91.6	76	82.6	0.6	1.9	1	10.7	4.89	49.4	131	83.0	83	196	1.49	6.5	47	6
5298	2B99-2657	2	39.4	90.4	83	82.4	0.2	1.7	1	10.3	4.82	50.6	127	93.3	100	196	1.50	7.0	41	10
5300	6B98-9022	6	35.9	91.4	85	80.1	0.9	2.5	2	10.8	4.45	44.3	136	55.0	137	168	1.58	36.0	49	4
5301	6B99-9170	6	34.3	73.7	86	79.1	0.7	1.7	1	12.5	5.26	43.3	160	68.1	272	214	1.58	7.4	56	2
5302	94Ab13449	6	35.5	73.2	81	78.4	1.8	n.d.	3	12.7	4.69	38.0	157	52.2	263	185	1.65	68.0	39	13
5303	98Ab11993	2	41.0	95.2	76	80.3	0.7	1.7	1	11.5	4.50	41.5	94	66.2	229	168	1.59	8.5	33	17
5304	98Ab12905	6	36.9	84.4	78	80.1	1.5	2.3	1	11.7	5.39	49.4	145	71.4	432	234	1.74	18.6	53	3
5305	98ID251	2	43.3	86.4	81	76.7	2.1	1.6	1	13.7	4.25	31.2	118	54.5	384	139	1.61	9.3	21	27
5306	BZ 598-036	2	44.1	91.3	70	75.4	2.4	n.d.	3	14.4	3.79	27.7	107	42.0	520	114	1.64	40.0	18	31
5307	YU 597-432	2	44.0	87.3	65	78.4	1.9	1.6	1	13.0	4.15	33.0	140	57.3	330	137	1.60	9.6	33	17
5308	YU598-043	2	47.1	97.6	69	76.9	2.3	n.d.	3	12.2	3.94	33.4	83	45.1	537	132	1.72	42.0	27	20
5309	MT970229	2	46.7	98.4	73	78.9	1.2	n.d.	3	11.4	4.00	36.0	92	42.7	491	142	1.65	47.0	23	24
5310	MT981091	2	46.2	93.7	73	79.5	2.0	1.9	2	11.8	3.94	36.5	109	40.1	572	131	1.64	18.0	36	15
5311	MT981238	2	46.4	96.2	76	79.1	1.8	1.8	1	13.1	5.10	40.3	123	69.4	598	196	1.62	7.3	42	8
5312	ND16301	6	35.9	86.5	82	79.4	0.9	n.d.	3	11.4	4.62	41.2	166	56.4	170	197	1.61	71.0	42	8
5313	ND19854	2	44.2	94.6	78	79.1	1.8	n.d.	3	12.1	4.52	38.1	153	52.1	578	172	1.74	73.0	41	10
5314	PB1-95-2R-522	2	43.0	79.0	76	76.6	2.7	2.1	2	11.7	3.70	33.5	69	38.1	772	133	1.86	24.0	20	28
5315	PB1-97-2R-7010	2	45.4	93.5	72	77.8	2.2	1.9	2	11.7	3.52	31.2	104	34.9	677	104	1.73	16.7	25	21
5316	Samish 23	2	41.3	90.7	73	77.3	2.8	n.d.	3	12.9	4.11	32.6	99	34.4	750	159	1.79	47.0	19	29
5317	UT97B1480-1534	6	36.6	77.8	70	72.4	*4.7	2.2	2	14.3	3.57	26.0	88	28.4	1048	125	*2.33	28.0	9	36
5318	UT00B1712-627	6	41.0	91.4	71	74.9	2.8	n.d.	3	12.7	4.29	34.4	143	38.2	732	135	1.77	43.0	31	19
5319	UT00B1718-773	6	38.5	89.9	75	74.0	2.8	n.d.	3	13.6	3.84	29.0	105	42.8	831	122	1.80	47.0	19	29
5320	WA 8569-99	2	38.9	69.0	74	74.9	2.8	n.d.	3	13.3	3.78	29.3	101	41.8	588	118	1.72	37.0	15	33
5321	WA 8601-97	2	39.8	72.0	79	75.8	2.2	n.d.	3	13.1	3.83	30.2	78	43.8	382	102	1.59	37.0	11	35

Table 5

Lab No.	Variety or Selection	Rowed	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	F-C (%)	Wort Color	Wort Clarity	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	FAN (ppm)	Visc. (Rel.)	Turb. (Hach)	Quality Score	Overall Rank
5322	WA 9701-99	2	38.4	85.8	78	78.6	1.5	n.d.	3	11.2	3.85	37.3	95	46.1	189	104	1.60	35.0	24	23
5323	WA 10497-97	2	38.0	87.8	84	78.4	2.2	1.4	1	11.3	4.13	37.6	100	48.2	469	166	1.64	14.8	25	21
5325	WA 10701-99	2	40.8	79.3	80	80.8	0.8	1.6	1	11.9	5.27	47.8	109	67.2	211	224	1.50	6.9	41	10
5326	Radiant (98-NZ 223)	2	39.6	76.4	78	80.5	2.0	1.5	1	9.9	3.64	38.5	83	56.3	276	125	1.58	10.4	23	24
5327	00NZ772	2	37.2	77.6	78	80.2	1.7	1.5	1	11.5	3.81	35.2	88	44.5	404	142	1.61	13.0	23	24
5328	99NZ102	6	38.7	76.2	80	79.0	1.5	2.5	2	10.5	4.56	44.5	106	71.3	154	224	1.51	27.0	36	15
5299	HARRINGTON MALT CHECK	2	38.7	86.7	79	81.6	0.4	1.9	1	12.7	6.01	49.3	125	89.0	104	262	1.48	5.6	45	
5324	MOREX MALT CHECK	6	34.6	85.6	79	80.3	0.5	2.2	1	12.1	5.93	49.6	132	71.4	151	320	1.50	13.0	49	
5329	MOREX MALT CHECK	6	35.3	87.4	77	79.7	0.3	2.2	1	12.4	5.90	49.8	124	72.0	182	293	1.52	13.5	49	
5330	HARRINGTON MALT CHECK	2	38.5	86.6	79	82.0	1.0	1.7	1	12.7	5.80	46.8	124	82.2	156	260	1.51	7.5	49	
Minima			34.0	68.2	65	72.4	0.2	1.4		9.7	3.19	26.0	58	28.4	60	102	1.49	6.5	9	
Maxima			47.1	98.4	86	83.3	2.8	2.5		14.4	5.39	51.1	173	93.3	1048	234	1.88	73.0	57	
Means			40.3	85.8	77	78.4	1.6	1.9		12.0	4.29	37.9	114	53.6	419	158	1.64	27.4	32	
Standard Deviations			3.7	8.5	5	2.5	0.8	0.3		1.2	0.57	7.0	29	15.5	246	41	0.10	19.9	13	
Coefficients of Variation			9.2	9.9	6	3.2	48.1	17.7		9.8	13.35	18.4	25	29.0	59	26	6.25	72.3	42	

Malt Check Data are Excluded from Rank Sorting and Statistics

Table Data Flagged by an Asterisk Exceed the Mean by +/- 3 Standard Deviations and are Excluded from Statistics

For Wort Clarity - 1 = clear, 2 = slightly hazy, 3 = hazy; Wort Colors were not determined (n.d.) on hazy samples

Samples Submitted by C. Sellmer, BARI - Ft. Collins, CO

2004 WESTERN REGIONAL SPRING BARLEY NURSERY - IDAHO FALLS, ID

Table 6

Lab No.	Variety or Selection	Rowed	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	F-C (%)	Wort Color	Wort Clarity	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	FAN (ppm)	Visc. (Rel.)	Turb. (Hach)	Quality Score	Overall Rank
5254	Steptoe	6	43.0	95.8	77	76.1	2.3	n.d.	3	9.8	3.28	34.1	60	32.8	816	100	*1.77	63.0	15	36
5255	Baronesse	2	43.3	95.8	77	78.6	1.0	n.d.	3	10.5	3.97	38.1	100	44.8	200	115	1.52	37.0	23	31
5256	Morex	6	35.5	87.2	81	80.2	1.2	1.4	1	12.0	4.88	42.8	160	60.9	309	184	1.55	8.0	54	2
5257	Stander	6	37.8	94.0	78	80.9	1.2	1.7	1	11.9	5.61	51.4	146	73.2	194	241	1.51	9.3	56	1
5258	Harrington	2	42.3	94.7	77	82.3	1.0	1.3	1	10.7	5.36	52.5	117	89.3	169	241	1.49	5.4	45	8
5259	2B97-4004	2	39.7	91.5	79	83.7	0.1	1.7	1	10.3	5.46	53.5	128	93.9	29	228	1.48	5.9	38	16
5260	2B99-2316	2	39.8	89.8	80	82.7	0.4	1.5	1	10.4	4.98	52.5	152	105.8	57	218	1.47	5.8	39	13
5261	2B99-2657	2	38.1	88.3	82	83.3	0.6	1.6	1	10.2	5.06	54.5	125	113.7	57	218	1.48	6.8	39	13
5262	6B98-9022	6	38.6	96.7	82	80.5	1.0	1.4	1	11.2	5.00	47.4	172	69.7	93	179	1.50	8.6	51	3
5263	6B99-9170	6	40.0	95.6	82	81.2	0.2	1.8	1	11.3	5.80	53.6	147	83.0	196	234	1.51	7.8	44	10
5264	94Ab13449	6	38.4	92.8	65	81.4	0.8	n.d.	3	9.6	4.77	53.9	96	58.7	220	197	1.55	*104	32	21
5265	98Ab11993	2	42.4	95.8	75	82.3	0.1	1.4	1	10.0	4.76	48.8	102	85.1	74	185	1.53	8.8	45	8
5266	98Ab12905	6	37.6	96.3	70	82.7	0.8	2.2	1	9.7	4.95	55.4	80	82.4	330	229	1.58	18.6	34	19
5267	98ID251	2	44.8	95.2	84	79.7	0.6	1.9	1	11.3	4.70	42.0	100	56.7	225	158	1.53	13.4	39	13
5268	BZ 598-036	2	44.3	95.9	73	79.0	0.9	n.d.	3	11.3	4.07	38.9	93	49.4	279	136	1.54	50.0	26	26
5269	YU 597-432	2	43.1	92.5	67	80.4	0.7	1.6	2	11.5	4.61	42.5	135	67.5	171	146	1.51	13.3	48	6
5270	YU598-043	2	48.2	96.2	66	77.0	1.1	n.d.	3	11.6	4.24	38.6	96	44.7	514	117	1.63	57.0	24	27
5271	MT970229	2	46.0	96.4	80	79.0	1.1	n.d.	3	11.4	4.25	38.7	97	41.9	433	129	1.57	68.0	23	31
5272	MT981091	2	45.2	94.8	67	80.0	1.4	1.2	2	11.1	4.08	37.6	109	38.3	487	137	1.56	11.3	31	23
5273	MT981238	2	43.8	85.3	75	80.0	1.0	1.4	1	12.0	5.20	44.2	118	75.7	541	190	1.55	6.4	50	5
5274	ND16301	6	39.0	95.5	82	81.1	0.5	1.6	1	10.0	4.88	50.5	144	70.3	97	197	1.52	23.0	51	3
5276	ND19854	2	43.8	95.2	75	80.6	0.8	1.9	2	11.2	4.56	41.0	140	57.4	337	151	1.55	46.0	40	12
5277	PB1-95-2R-522	2	47.0	95.3	74	79.2	1.2	1.4	2	10.8	4.18	40.2	64	40.3	442	152	1.54	21.0	24	27
5278	PB1-97-2R-7010	2	48.9	96.6	73	79.2	1.2	2.0	2	11.3	4.29	40.9	116	37.9	398	148	1.54	32.0	28	25
5279	Samish 23	2	39.9	91.8	74	79.0	2.4	1.7	2	11.6	4.21	38.2	95	31.9	611	144	1.60	40.0	22	33
5280	UT97B1480-1534	6	37.6	86.6	65	76.0	2.0	1.4	2	11.1	3.67	33.9	86	27.5	736	138	*1.69	27.0	16	35
5281	UT00B1712-627	6	40.3	94.3	62	76.8	0.8	2.9	2	11.1	4.52	40.8	134	37.6	539	193	1.53	50.0	24	27
5282	UT00B1718-773	6	38.5	94.3	65	77.5	1.4	2.6	2	10.6	4.01	39.2	92	40.5	447	166	1.57	55.0	20	34
5283	WA 8569-99	2	42.3	92.7	78	79.3	1.4	2.2	2	10.5	3.82	39.4	90	39.2	350	300	1.60	43.0	24	27
5284	WA 8601-97	2	44.7	94.9	70	79.5	0.4	n.d.	3	10.7	4.07	38.5	91	45.6	135	136	1.55	65.0	32	21

Table 6

Lab No.	Variety or Selection	Rowed	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	F-C (%)	Wort Color	Wort Clarity	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	FAN (ppm)	Visc. (Rel.)	Turb. (Hach)	Quality Score	Overall Rank
5285	WA 9701-99	2	40.4	92.2	76	79.4	0.8	n.d.	3	11.1	3.95	37.7	104	43.7	125	124	1.54	44.0	29	24
5286	WA 10497-97	2	41.9	97.2	81	79.6	0.7	1.7	1	11.2	4.28	41.0	103	47.1	275	152	1.52	10.9	34	19
5287	WA 10701-99	2	43.4	92.1	79	82.6	0.3	1.6	1	10.9	5.27	53.3	95	78.7	170	227	1.48	8.7	44	10
5288	Radiant (98-NZ 223)	2	41.0	92.0	77	81.4	0.7	3.2	1	10.0	4.06	40.9	88	70.0	162	145	1.51	16.6	36	18
5289	00NZ772	2	43.1	94.7	70	81.3	0.4	3.0	1	11.0	4.08	39.0	97	45.4	194	156	1.50	20.0	37	17
5290	99NZ102	6	40.1	87.5	71	79.9	0.8	1.8	2	9.9	5.20	53.2	109	79.2	122	226	1.50	31.0	47	7
5275	HARRINGTON MALT CHECK	2	38.6	86.2	77	82.2	1.3	1.5	1	13.0	6.18	51.0	133	95.8	93	267	1.48	7.5	41	
Minima			35.5	85.3	62	76.0	0.1	1.2		9.6	3.28	33.9	60	27.5	29	100	1.47	5.4	15	
Maxima			48.9	97.2	84	83.7	2.4	3.2		12.0	5.80	55.4	172	113.7	816	300	1.63	68.0	56	
Means			41.8	93.4	75	80.1	0.9	1.8		10.9	4.56	44.1	111	60.0	293	176	1.53	26.8	35	
Standard Deviations			3.2	3.2	6	1.9	0.5	0.5		0.7	0.59	6.7	26	22.2	197	46	0.04	20.1	11	
Coefficients of Variation			7.7	3.4	8	2.4	58.4	29.1		6.1	13.02	15.2	24	36.9	67	26	2.42	75.1	32	

Malt Check Data are Excluded from Rank Sorting and Statistics

Table Data Flagged by an Asterisk Exceed the Mean by +/- 3 Standard Deviations and are Excluded from Statistics

For Wort Clarity - 1 = clear, 2 = slightly hazy, 3 = hazy; Wort Colors were not determined (n.d.) on hazy samples

Samples Submitted by C. Sellmer, BARI - Ft. Collins, CO

2004 WESTERN REGIONAL SPRING BARLEY NURSERY - TWIN FALLS, ID

Table 7

Lab No.	Variety or Selection	Rowed	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	F-C (%)	Wort Color	Wort Clarity	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha-amylase (20°DU)	Beta-glucan (ppm)	FAN (ppm)	Visc. (Rel.)	Turb. (Hach)	Quality Score	Overall Rank
5216	Steptoe	6	42.1	95.5	68	75.8	1.7	n.d.	3	9.3	3.27	36.8	124	69.9	837	107	*1.82	63.0	26	28
5217	Baronesse	2	42.1	95.5	65	77.7	1.2	n.d.	3	11.1	3.87	35.5	153	61.5	368	119	1.61	37.0	29	24
5218	Morex	6	34.7	86.3	60	78.6	0.8	1.6	1	13.7	5.41	42.0	136	45.1	314	216	1.57	7.3	47	7
5219	Stander	6	36.0	94.1	75	80.3	0.4	1.7	1	10.9	5.23	51.7	169	66.9	286	232	1.60	9.3	48	6
5220	Harrington	2	39.4	79.5	70	79.0	0.9	1.8	1	13.5	5.57	43.2	182	68.8	332	225	1.57	13.6	27	26
5221	2B97-4004	2	38.5	88.5	65	82.4	0.3	2.3	1	11.5	5.59	51.9	145	73.2	72	239	1.53	15.7	50	4
5222	2B99-2316	2	39.0	92.6	61	81.7	0.4	1.8	1	11.7	5.24	48.8	145	57.6	130	220	1.51	6.8	53	1
5223	2B99-2657	2	38.3	93.0	72	83.0	0.2	1.9	1	10.0	5.01	52.6	165	58.0	45	198	1.51	9.9	45	10
5224	6B98-9022	6	35.5	95.4	65	79.1	0.9	1.4	1	12.4	4.99	42.8	180	66.2	256	189	1.62	9.3	51	3
5226	6B99-9170	6	36.4	96.3	72	81.1	0.6	1.7	1	10.7	4.99	50.8	140	55.3	238	207	1.56	9.0	44	11
5227	94Ab13449	6	34.3	85.2	57	80.9	1.4	2.1	2	10.2	4.79	51.1	147	56.3	99	204	1.53	27.0	47	7
5228	98Ab11993	2	39.3	93.0	59	81.2	0.6	1.6	1	10.8	4.82	48.4	83	65.5	116	205	1.55	7.4	37	12
5229	98Ab12905	6	34.2	90.8	62	82.0	0.9	2.2	1	9.4	4.80	54.9	91	72.0	206	218	1.53	15.6	37	12
5230	98ID251	2	45.6	94.3	70	78.2	0.8	1.4	1	12.4	4.49	39.0	93	55.6	226	155	1.55	9.6	33	19
5231	BZ 598-036	2	44.2	96.9	60	79.2	0.2	2.6	2	9.5	3.89	44.0	74	49.4	167	135	1.54	33.0	35	15
5232	YU 597-432	2	41.4	95.0	59	80.4	0.9	1.4	1	10.9	4.04	39.0	109	58.0	205	140	1.56	9.1	34	18
5233	YU598-043	2	41.2	87.7	61	76.9	1.8	2.2	2	10.9	3.82	35.9	64	44.2	506	120	1.62	34.0	17	34
5234	MT970229	2	46.2	94.3	68	78.8	0.8	2.4	2	11.3	4.27	40.0	78	44.0	479	143	1.59	35.0	24	31
5235	MT981091	2	39.6	85.9	63	80.5	1.0	1.4	1	9.5	3.81	42.9	85	43.8	280	139	1.51	9.4	28	25
5236	MT981238	2	43.1	93.3	67	80.6	0.9	1.6	1	12.0	5.16	46.2	103	68.3	395	210	1.53	8.8	52	2
5237	ND16301	6	36.3	92.8	75	80.2	1.3	1.6	1	11.3	4.81	45.8	156	64.0	264	187	1.61	13.0	49	5
5238	ND19854	2	39.9	92.9	62	81.3	0.7	n.d.	3	10.6	4.22	42.0	109	54.1	332	155	1.57	68.0	33	19
5239	PB1-95-2R-522	2	39.6	73.9	73	77.7	2.6	1.4	1	10.7	3.92	38.0	51	42.3	584	129	1.60	10.6	13	35
5240	PB1-97-2R-7010	2	41.2	84.9	74	79.9	0.8	n.d.	3	9.6	4.17	45.7	72	41.2	283	131	1.58	55.0	25	29
5241	Samish 23	2	38.3	86.6	72	79.8	2.0	1.7	2	10.9	4.33	43.2	88	42.5	471	136	1.56	16.4	27	26
5242	UT97B1480-1534	6	34.1	78.5	61	74.4	2.8	n.d.	3	11.4	3.53	31.6	90	32.0	812	98	*1.80	26.0	13	35
5243	UT00B1712-627	6	39.5	95.1	57	77.0	0.7	n.d.	3	11.0	4.51	43.2	115	43.4	420	149	1.56	41.0	24	31
5244	UT00B1718-773	6	36.5	94.2	52	76.7	1.3	n.d.	3	10.1	3.98	39.9	90	43.6	509	131	1.60	40.0	19	33
5245	WA 8569-99	2	42.0	94.7	73	79.5	1.5	n.d.	3	10.3	4.05	41.3	82	44.5	319	116	1.60	29.0	25	29
5246	WA 8601-97	2	43.1	94.1	72	79.2	1.4	n.d.	3	11.6	4.28	38.5	82	45.3	308	126	1.55	37.0	31	23

Table 7

Lab No.	Variety or Selection	Rowed	Kernel Weight (mg)	on 6/64" (%)	Barley Color (Agtron)	Malt Extract (%)	F-C (%)	Wort Color	Wort Clarity	Barley Protein (%)	Wort Protein (%)	S/T (%)	DP (°ASBC)	Alpha- amylase (20°DU)	Beta- glucan (ppm)	FAN (ppm)	Visc. (Rel.)	Turb. (Hach)	Quality Score	Overall Rank
5247	WA 9701-99	2	37.9	91.8	73	80.7	0.5	n.d.	3	9.3	3.94	45.6	84	48.9	57	116	1.54	30.0	32	22
5248	WA 10497-97	2	40.7	95.8	71	79.9	0.7	1.4	1	10.9	4.45	44.3	96	51.1	352	150	1.57	11.5	35	15
5249	WA 10701-99	2	41.0	82.0	70	81.7	0.7	1.6	1	11.4	5.67	52.0	105	72.8	291	211	1.53	10.1	35	15
5251	Radiant (98-NZ 223)	2	39.2	83.3	62	80.1	1.0	1.9	1	12.2	5.07	45.2	107	68.9	174	177	1.54	13.7	47	7
5252	00NZ772	2	38.2	82.7	69	81.3	1.2	1.8	2	10.6	4.48	44.4	89	51.4	137	178	1.51	16.8	33	19
5253	99NZ102	6	38.0	87.5	60	78.9	0.7	2.6	2	11.2	5.80	52.6	114	78.0	189	253	1.57	24.0	36	14
5225	HARRINGTON MALT CHECK	2	39.0	85.4	76	81.5	0.5	1.6	1	12.8	5.77	47.7	131	58.2	98	252	1.50	6.9	51	
5250	HARRINGTON MALT CHECK	2	38.2	86.6	78	81.6	0.3	1.5	1	12.8	6.16	49.8	141	86.0	99	242	1.48	6.0	45	
Minima			34.1	73.9	52	74.4	0.2	1.4		9.3	3.27	31.6	51	32.0	45	98	1.51	6.8	13	
Maxima			46.2	96.9	75	83.0	2.8	2.6		13.7	5.80	54.9	182	78.0	837	253	1.62	68.0	53	
Means			39.4	90.1	66	79.6	1.0	1.8		11.0	4.56	44.2	111	55.7	307	168	1.56	22.6	34	
Standard Deviations			3.1	5.8	6	1.9	0.6	0.4		1.1	0.65	5.6	35	11.7	185	44	0.03	16.3	11	
Coefficients of Variation			7.9	6.5	9	2.4	59.0	20.7		9.8	14.27	12.8	31	21.1	60	26	2.09	72.3	32	

Malt Check Data are Excluded from Rank Sorting and Statistics

Table Data Flagged by an Asterisk Exceed the Mean by +/- 3 Standard Deviations and are Excluded from Statistics
 For Wort Clarity - 1 = clear, 2 = slightly hazy, 3 = hazy; Wort Colors were not determined (n.d.) on hazy samples

Samples Submitted by C. Sellmer, BARI - Ft. Collins, CO

Appendix A:

METHODS

Cleaning All samples were cleaned on a Carter Dockage Tester and any material not retained on a 5/64" screen was discarded.

Barley Mill Ground barley was prepared with a Labconco Burr mill that was adjusted so that only 35% of the grist remained on a 525 μ m sieve after 3 min of shaking and tapping.

Kernel Weight The number of kernels in a 20 g aliquot of each sample was counted electronically and the '1000 kernel weight' was calculated.

Plumpness Samples were sized on a Eureka-Niagra Barley Grader and the percentage of the seeds retained on a 6/64" screen was determined.

Barley Color The brightness of the grains was measured using an Agtron M45-D analyzer.

Barley Moisture Content Five g of ground sample was dried for 3 h at 106°C. The percentage of weight loss that occurred during this drying was calculated.

Barley Protein Content Total nitrogen values were obtained using an automated Dumas combustion procedure with a LECO FP-528 analyzer. Nitrogen values were converted to protein percentages by multiplication by 6.25.

Malting Conditions 170 g (db) barley samples were steeped at 16°C for 32-48 h, to 45% moisture, by alternating 4 h of wet steep with 4 h of air rest. The steeped samples were placed in a chamber for 5 d at 17°C and near 100% R.H., in cans that were rotated for 3.0 min every 30 min. The germinated grain (green malt) was kilned for 24 h as follows: 0.5 h from 25°C to 49°C, 9.5 h at 49°C, 0.5 h from 49°C to 54°C, 4.0 h at 54°C, 0.5 h from 54°C to 60°C, 3.0 h at 60°C, 0.5 h from 60°C to 68°C, 2.0 h at 68°C, 0.5h from 68°C to 85°C, and 3.0 h at 85°C.

Malt Mill Fine-grind malts were prepared with a Miag laboratory cone mill that was adjusted so that 10% of the grist remained on a 525 μ m sieve after 3 min of shaking, with tapping. Coarse-grind malts were prepared with a corrugated roller mill that was adjusted so that 75% of the grist remained on a 525 μ m sieve. Ground malts for moisture, protein and amyolytic activity analyses were ground in a Labconco Burr mill (see Barley Mill).

Malt Moisture Content See Barley Moisture Content.

Malt Protein Content See Barley Protein Content.

Malt Extract Samples were extracted using the Malt-4 procedure (Methods of Analysis of the ASBC, 8th ed, 1992), except that all weights and volumes specified for the method were halved. The specific gravity of the filtrate was measured with an Anton/Parr DMA5000 density meter. The density data were used to calculate the amount of soluble material present in the filtrate, and thus the percentage that was extracted from the malt. **F-C** represents the difference in extract % between the finely ground malts and the coarsely ground malts.

Wort Color was determined on a Skalar SAN plus analyzer by measuring the absorbance at 430nm and dividing by a factor that was determined by comparison with values obtained in a collaborative test.

Wort Clarity was assessed by visual inspection.

β -Glucan Levels were determined on a Skalar SAN plus analyzer by using the Wort-18 fluorescence flow injection analysis method with calcofluor as the fluorescent agent (Methods of Analysis of the ASBC, 8th ed, 1992).

Free Amino Nitrogen Levels were determined on a Skalar SAN plus analyzer using an automated version of the Wort-12 protocol (Methods of Analysis of the ASBC, 8th ed, 1992).

Soluble (Wort) Protein Levels were determined on a Skalar SAN plus analyzer using the Wort-17 UV-spectrophotometric method (Methods of Analysis of the ASBC, 8th ed, 1992).

S/T Ratio was calculated as Soluble Protein / Total Malt Protein

Diastatic Power Values were determined on a Skalar SAN plus analyzer by the automated ferricyanide procedure Malt-6A (Methods of Analysis of the ASBC, 8th ed, 1992).

α -Amylase activities were measured on a Skalar SAN plus analyzer by heating the extract to 73°C to inactivate any β -amylase present. The remaining (α -amylase) activity was measured as described for Diastatic Power Values.

Turbidities were determined in Nephelometric Turbidity Units (NTU) on a Hach Model 18900 Ratio Turbidimeter.

Quality Scores were calculated by using a modification of the method of Clancy and Ullrich (Cereal Chem. 65:428-430, 1988). The criteria used to quantify individual quality factors are listed in Table A1.

Overall Rank Values were ordered from low to high based on their Quality Scores. A rank of '1' was assigned to the sample with the best quality score.

Appendix B

2004 Crop Year

Quality Score Parameters for 2- and 6-rowed barleys

Quality parameter	2-rowed		6-rowed	
	condition	score	condition	score
Kernel Weight (mg)	> 42.0	5	> 32.0	5
	40.1–42.0	4	30.1–32.0	4
	38.1–40.0	2	28.1–30.0	2
	≤ 38.0	0	≤ 28.0	0
on 6/64 " (%)	≥ 90.0	5	≥ 80.0	5
	85.0–89.9	3	73.0–79.9	3
	< 85.0	0	< 73.0	0
Malt Extract (% db)	≥ 81.0	10	≥ 79.0	10
	79.4–81.0	7	78.2–78.9	7
	78.0–79.4	4	77.7–78.2	4
	< 78.0	0	< 77.7	0
Wort Clarity	= 3	0	= 3	0
	3=hazy	= 2	= 2	1
	2=slightly hazy	= 1	= 1	2
	1=clear			
Barley Protein (% db)	≥ 13.5	0	≥ 14.0	0
	13.0–13.5	5	13.5–13.9	5
	11.5–13.0	10	11.5–13.5	10
	≤ 11.5	5	≤ 11.5	5
Wort Protein (% db)	> 6.0	0	> 6.0	0
	5.6–6.0	3	5.7–6.0	3
	4.9–5.6	7	5.2–5.7	7
	4.5–4.9	3	4.8–5.2	3
	< 4.5	0	< 4.8	0
S/T (Soluble/Total Protein, % db)	> 47	0	> 47	0
	42–47	5	42–47	5
	< 42	0	< 42	0
DP (Diastatic Power, ° ASBC)	> 180	0	> 200	0
	160–180	4	180–200	4
	120–160	7	140–180	7
	100–120	4	120–140	4
	< 100	0	< 120	0
Alpha-amylase (20° DU)	> 90	0	> 90	0
	80–90	4	80–90	4
	45–80	7	45–80	7
	35–45	4	35–40	4
	< 35	0	< 35	0
Beta-glucan (ppm)	< 40	0	< 40	0
	40–60	3	40–80	3
	60–115	7	80–140	7
	115–200	3	140–200	3
	> 200	0	> 200	0